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ORIGINAL RESEARCH



Influence of Behavioral and Social Factors on Gastric Cancer Incidence and Mortality



Authors' Contribution:

A – Study design;
B – Data collection;
C – Statistical analysis;
D – Data interpretation;
E – Manuscript preparation;
F – Literature search;
G – Funds collection

Nikolov A.¹ ABCDEFG , Georgieva L.² DEFG

¹ Dental Clinic "Zahnzentrum Rudow", Germany

² Medical University – Sofia, Bulgaria

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Background and Aim of Study:

Abstract

The significance of the risk factors, including behavioral and social characteristics of the patients, for the occurrence of stomach cancer is constantly increasing and largely determines the development and outcome of the disease. The aim of the study: to provide empirical data for the significance of behavioral and social factors on gastric cancer incidence and mortality.

Material and Methods:

Data from a study of gastric cancer patients (234 men and 144 women) examined at the Heidelberg University Clinic (Germany) were used. Risk factors, gastric cancer survival and mortality, factors of fatal outcome of gastric cancer patients were compared. Multiple binary logistic regression analysis was used to quantitatively assess their influence. To analyze the possible statistical significance between different groups, we used Fisher's exact test and chi-squared test for the relationship between categorical variables and Student's t-test. The significance level (rejecting the null hypothesis) is $p < 0.05$.

Results:

The most common risk factors are lack of physical activity, smoking, accompanying cardiovascular diseases, as well as emotional stress. Unhealthy lifestyle increases the risk by 56.8%. With a lower but significant percentage are overweight and alcohol abuse. We found the presence of emotional stress in 25.3% of patients with stomach cancer. Jobs with primary mental work and high stress level increase the probability of negative outcome. Mainly mental work is associated with about 8 times the risk of death compared to physical work. The presence of stress increases the lethal risk about 3.2 times.

Conclusions:

Risk factors related to healthy lifestyle of the patients, including mental health, play an important role in the development of stomach cancer. They largely determine the status, disease control, treatment, survival and mortality of gastric cancer patients.

Keywords:

risk factors, survival and mortality, smoking, stress, physical inactivity, overweight, alcohol abuse

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Information about the authors:

Nikolov Alexander (Corresponding Author) – <https://orcid.org/0000-0001-5414-9378>; alexander_nikolov1988@yahoo.de; PhD Student, Dental Clinic "Zahnzentrum Rudow", Berlin, Germany.

Georgieva Lidia – <https://orcid.org/0000-0002-9320-9203>; Doctor of Medical Sciences, MD, Professor, Medical University – Sofia, Sofia, Bulgaria.



Introduction

Malignant diseases, including stomach cancer, are among the biggest health problems nowadays. Stomach cancer is the fifth most common cancer in the world and the third most common cause of death due to cancer. While behavior related risk factors (e.g., smoking, alcohol abuse) were often investigated in previous research (den Hoed & Kuipers, 2016; Dong & Thrift, 2017), we suggest that socio-economic factors can also play an important role and do not have to be neglected in prevention programs. For instance, early research suggest that stress influences the carcinogenic process (Sklar & Anisman, 1981). Further study found that in indigenous populations there is a higher burden of stomach cancer (Arnold et al., 2014). Also ethnic-specific differences were found in an U.S. study (Camargo et al., 2011).

There are several previous studies, which analyze the role of socio-economic factors on the incidents and mortality of gastric cancer (Dong & Thrift, 2017; Kim et al., 2020; Sarkar et al., 2022; Song et al., 2015; Tonelli et al., 1997). However, they are relatively few in number and the results are mainly contradictory to each other. Moreover, they do not look into factors such as job type or stress level on the probability of having gastric cancer or of negative outcome.

Medical and social support factors are important for the quality of life of oncology patients (Nikolov & Georgieva, 2022).

Understanding the role of socio-economic factors on incidence and mortality can contribute improving the health care of groups in the society, which are most prone to have high incidence and high mortality rate.

The aim of the study. To provide empirical data for the significance of behavioral and social factors on gastric cancer incidence and mortality. In particular, we focus on the analyses of the role of the factors, which affect the increase of life expectancy and quality of life of stomach cancer patients, as well as we discuss potential mitigation of the negative mental and social impacts of the disease.

Materials and Methods

In order to address the research questions, we have conducted a retrospective clinical-epidemiological study with 378 people diagnosed with gastric cancer. The study focusses on a comparative analysis of behavioral, socio-medical, epidemiological and psychosocial aspects of gastric cancer. The data were collected at the University Clinic in Heidelberg, Germany, using especially design questionnaire. To create the data set, we have used documents from the University Clinic over a 13-year period, including patient examination reports, pathological examinations, discharge information and other clinical documents. Information on the following variables was collected: health-related behavior and social characteristics of the patients, accompanying diseases, as well as psychosocial context and self-reported opinion about their own health assessed using a standardized questionnaire. The final sample consists of 234 (61.9%) men and 144 (38.1%) women.

The data were analyzed using statistical software IBM SPSS Statistics 25.0 and MedCalc Version 19.6.3. In the first part of the analyzes, we used descriptive statistics to analyze potential differences between patients with different characteristics. After that, the following tests were performed in order to analyze potential statistical significance between the different groups: Fisher's exact test and chi-square test for the relationship between categorical variables and Student's t-test or Mann-Whitney. The level of significance at which the null hypothesis is rejected was $p < 0.05$. Additionally, Multiple binary logistic regression analysis was applied to establish the factors for fatal outcome from stomach cancer and quantitative assessment of their influence. Kolmogorov-Smirnov and Shapiro-Wilk test were performed to test the assumption of normal distribution of the metric variables.

Results

Distribution of Potential Risk Factors in Gastric Cancer Patients

The results of the comparative analysis of the frequency distribution of potential risk factors among the patients are summarized in Table 1. The results suggest that the most common factor is lack of physical activity (79.5%), followed by smoking (53.6%) and accompanying cardiovascular diseases (45.5%). With lower but noticeable frequency are overweight (18.6%) and alcohol abuse (6.7%).

Table 1

Frequency Distribution of Potential Risk Factors

Indicators	Patients	
	Person (n)	Percentage (%)
Physical activity		
Yes	77	20.5
No	298	79.5
Smoking		
Yes	200	53.6
No	173	46.4
Cardiovascular diseases		
Yes	142	45.5
No	170	54.5
Unhealthy eating		
Yes	124	33.1
No	251	66.9
Presence of stress*		
Yes	108	28.6
No	270	71.4
Higher education		
Yes	92	24.6
No	282	75.4
Overweight		
Yes	70	18.6
No	306	81.4
Alcohol abuse		
Yes	25	6.7
No	350	93.3

Note. *According to self-reported patient's opinion.



The mean age of the patients was $M=62.11$ ($SD=12.71$) years, ranging between 24 and 93 years old. A significant gender differences is found only for the presence of accompanying cardiovascular diseases – the relative share in men is statistically significantly greater than that those of women, $\chi^2(1, N=312)=3.945$, $p=0.049$ (see Table 2). Among the patients with cardiovascular

diseases were 95 (66.9%) male and 47 (33.1%) female. The results of the analyzes of the further risk factors show no statistically significant relationship between gender and the indicators of physical activity, smoking, unhealthy diet, presence of stress, education, overweight and alcohol abuse.

Table 2

Analysis of the Relationship between Gender and Cardiovascular Disease

Gender	Absence of cardiovascular diseases		Presence of cardiovascular diseases	
	People (n)	Percentage (%)*	People (n)	Percentage (%)*
Male	95	55.9	95	66.9
Female	75	44.1	47	33.1

Note. *Percentage (%) refers to the relative frequency of each of the gender group within the patients with or without cardiovascular diseases (e.g., 55.9% of the patients without cardiovascular diseases were male).

Concomitant cardiovascular diseases were, as expected, more common in the age groups 60-74 and 75+ years old, while in the two younger groups – 15-44 and 45-59 years old – they were less common. Interestingly, unhealthy eating prevails among the oldest patients (75+ years) and has a significantly smaller relative share in the 45-59 age group. The presence of the self-reported stress dominates among the oldest patients (75+ years) and has a significantly smaller relative share in the age group 15-44 years old. The group of patients between 15 and 44 years old has a significantly higher percentage of graduates than the other age groups.

With regard to their marital status, the study participants were divided into 4 groups: married – 185 people or 48.9%, single – 108 people or 28.6%, divorced – 44 people or 11.6% and widowed – 41 people or 10.8%. Marital status does not correlate with indicators of physical activity, cardiovascular disease, unhealthy diet and presence of stress. A statistically significant relationship between marital status and smoking was found: the widowed and married patients have significantly higher rates of smokers than single patients do. Higher education has a significantly higher relative share of married persons and consequentially a significantly smaller share for unmarried. Overweight and alcohol abuse were significantly more among married persons and significantly less among unmarried persons.

Factors that Affect the Fatal Outcome

Just over the half of the patients (51.9%) in the sample were still alive at the time point of the study, 182 (48.1%) were dead. Before comparing the groups of deceased and survived participants with regard to their socio-economic characteristics, we first compared them regarding clinical severity. For this purpose, the tumor stage indicator, known for its objectivity and in formativeness, was used. The results of the performed Fisher-Freeman-Halton exact test show no statistically significant difference in the frequency distribution of patients by the categories of the tumor stage indicator, meaning that the two groups were statistically equal in terms of clinical severity. This is a good prerequisite for correctly performing the subsequent comparisons.

The results comparative analysis of survived and deceased patient groups with regard to various socio-economic characteristics and health-related behavior of the patients show significant differences in age, education, marital status, type of work, smoking and alcohol abuse. The deceased patient group has statistically significantly higher average age, a higher percentage of smokers, university graduates, alcohol abusers, married and persons having a job with mainly mental work. The survived patient group has a statistically significantly lower average age and lower share of non-smokers, are rather persons with secondary or primary education, not abusing alcohol, are divorced or single, and persons with jobs that include mainly physical work. For the rest of the indicators, the difference between the two considered groups is not statistically significant.

The results of a multiple binary regression analysis that analyzed the factors that potentially influence fatal outcome from stomach cancer are summarized in Table A.

Marital status has the greatest influence – the risk of fatal outcome for married compared to not married persons is about 257 times greater. On second place as an indicator is the type of work, with the risk of a fatal outcome being about 27 times greater for those performing primarily mental work compared to those with primarily physical work. Further factors with significant influence are smoking behavior, alcohol abuse and higher education. With borderline significance ($p<0.10$) are the indicators age and unhealthy diet.

In order to consider the combined influence of the studied indicators and eliminate possible confounding factors, we put the variables all together in the regression equation and applied the “Backward conditional” procedure. The achieved percentage of correct answers from the classification table was 86.5. Thus, in the final version of the equation ($p<0.001$), five of the studied indicators remain – marital status, type of work, presence of stress, smoking and age. The obtained results give us reason to claim that, compared to unmarried, widowers have about 70 times higher risk of dead, married – about 47, and divorced – about 7 times. Mainly mental versus



mainly physical work is associated with about 8 times the risk of death. The presence of stress increases the lethal risk about 3.2 times, and smoking – about two times. Smoking is associated with an approximately 2.1-fold increased risk of death, and a 1-year increase in age increases the risk of death by approximately 2.0%.

Discussion

This study analyses the influence of behavioral and socio-economic factors on gastric cancer incidence and mortality based on a retrospective study.

Firstly, unhealthy behavior impacts the probability for gastric cancer. Smoking is commonly found to be a risk factor for gastric cancer in both our study and previous one (e.g., Dong & Thrift, 2017; Popp et al., 2022). Also, our study confirms that alcohol consumption and abuse increase the risk of gastric cancer. Our study confirms also the role of a healthy lifestyle including healthy eating, smoking cessation, low alcohol consumption and adequate physical activity, which were found to play an important role in cancer prevention also in previous research (e.g., den Hoed & Kuipers, 2016). The role of healthy eating was also analyzed in further previous studies. The results of an early study indicate that “hard grains, food with high sodium-chloride concentration, or surfactants” might favor the gastric carcinoma (Correa et al., 1975). A high intake of salted, pickled or smoked foods, as well as dried fish and meat and refined carbohydrates are thought to significantly increase the risk of developing stomach cancer, while fibre, fresh vegetables and fruit appear to be inversely proportional to the risk. According to healthy stomach cancer prevention programs, proper dietary habits should be implemented from childhood by increasing the intake of vegetables (Compare et al., 2010). This was also observed in our study. Diet and lifestyle, proper nutrition and improving people’s awareness level is vital for early diagnosis and timely treatment of gastric cancer, especially in people with family burden and genetic predisposition (Kim et al., 2020; Yusefi et al., 2018). Our study confirms this dependence. The study highlights therefore the importance of efforts to control the global burden of stomach cancer by reducing alcohol and tobacco use as well as to promote overall a healthier lifestyle. A combination of such treatments with other measures, such as proposed oral treatment (Hoff et al., 1998) or similar approaches can be explored in further studies.

Secondly, low socio-economic status is associated with an increased risk of morbidity and mortality from many diseases. A number of studies have observed associations between gastric cancer incidence and education, occupation, and income as indicators of socioeconomic status. In 36 studies, an increased risk of gastric cancer was observed in the lowest socioeconomic statuses compared to the highest (see meta-analyses by Uthman et al., 2013). Although the association between gastric cancer incidence and income level is evident, it does not reach statistically significant levels. In conclusion, it can be noted that the risk of gastric cancer incidence is higher

in groups with low socio-economic status (Sarkar et al., 2022; Uthman et al., 2013).

Thirdly, in our study, it is suggested that social support and education may influence the development of the disease to some extent. In an early study conducted by Siegrist & Siegrist (1987) with 1,444 patients with gastric cancer, this hypothesis could not be confirmed. Therefore, we provide empirical evidence for the role of these factors.

Asplund et al. (2021) found no prognostic influence for gender or education, which is matched by our study. Results were similar for 3-year disease-specific mortality.

Fourthly, in our study, we hypothesize that compared to office workers, unemployed and physically active individuals have an increased risk of gastric cancer. In the study by Kuwahara et al. (2010), the type of work and education was not associated with the risk of gastric cancer. In a recent study, Sarkar et al. (2022) found that gastric cancer cases more commonly held jobs in unskilled labor (compared to professional occupation). Therefore, we have provided here additional empirical evidence about the relationship between the type of work and the risk of cancer or a negative outcome from it, even though our results do not align completely with the results provided by Sarkar et al. (2022).

According to the data from our study, it is suggested that the survival rate is lower in gastric cancer patients with lower socio-economic status. Looking at 42 other studies on the relationship between survival rates of gastric cancer patients and SOC we observed that most studies consistently also reported that patients with lower SOC had lower survival rates than patients with high SOC (see overview by Kogevinas & Porta, 1997; Tabuchi, 2020). This study has several limitations. The localization of the study is limited to the University Clinic in Heidelberg, Germany, and the sample of study participants by individual groups is not large enough. Nevertheless, there is a definite trend that is obtained in the study.

Conclusions

The most pronounced risk factor that we found in the conducted study is an unhealthy lifestyle (unhealthy diet and, accordingly, overweight, lack of physical activity), which increases the risk of stomach cancer by 56.8%. Unhealthy lifestyle factors include the systematic use of alcohol, cigarettes and narcotics. In this way, the risk of stomach cancer increases up to 6 times. Therefore, education and promotion of a healthy lifestyle is still a very effective way to prevent gastric cancer and negative outcomes of it.

Secondly, as a risk factor, we can point to the presence of emotional stress, which we found in 25.3% of patients with stomach cancer. Therefore, in addition to physical health, also mental health should be increasingly put on focus of health care. This fact deserves particular attention, as it is likely to increase as technology advances.



Ethical Approval

The study protocol was consistent with the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a prior approval by the Institution's Human Research Committee.

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Table A

Ratio of Risks and Studied Potential Factors for Gastric Cancer Mortality

Indicators	Comparison	Multiple binary regression				Backward multiple binary regression			
		OR	95% CI		p	OR	95% CI		p
Marital status	Divorced/Single	8.368	1.619	43.255	0.011	6.767	1.216	37.651	0.029
	Married/Single	257.429	51.034	1298.536	<0.001	46.591	7.420	292.552	<0.001
	Widowed/Single	164.889	39.119	695.022	<0.001	69.874	15.221	320.763	<0.001
Type of work	Mostly mental/Mostly physical	26.782	14.163	50.646	<0.001	8.035	3.003	21.498	<0.001
	Mixed/Mostly physical	5.629	3.095	10.238	<0.001	1.702	0.692	4.188	0.247
Presence of stress according to the patient	Yes/No	1.368	0.872	2.145	0.172	3.228	1.341	7.768	0.009
Smoking	Yes/No	2.203	1.453	3.339	<0.001	2.102	0.974	4.535	0.058
Age	Increase by 1 year	1.015	0.999	1.032	0.065	1.023	0.996	1.051	0.097
Gender	Female/Male	0.900	0.594	1.365	0.621	-	-	-	-
Alcohol abuse	Yes/No	14.301	3.321	61.593	<0.001	-	-	-	-
Education	Higher/Secondary or primary	1.922	1.191	3.101	0.007	-	-	-	-
Unhealthy diet	Yes/No	1.459	0.947	2.247	0.087	-	-	-	-
Overweight	Yes/No	1.453	0.862	2.450	0.161	-	-	-	-
Cardiovascular diseases	Yes/No	1.358	0.869	2.124	0.179	-	-	-	-
Physical activity	Yes/No	1.122	0.679	1.855	0.653	-	-	-	-

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